Clinical Summary

Quality of CPR Performed on a Mattress Can Be Improved with a Novel CPR Feedback Device

Banville I, Rose L, O'Hearn P, et al. Quality of CPR Performed on a Mattress Can Be Improved with a Novel CPR Feedback Device. *Circulation*. 2011;124:A217.

Background:

Quality of CPR is often poor on soft surfaces such as a bed or stretcher, even with real-time feedback. High quality CPR consistent with the 2010 AHA Guidelines is even more difficult to achieve with minimum recommendations of at least 2" (50mm) depth at 100cpm.[1] Real-time CPR feedback technologies can help, but accelerometer-based devices may over-estimate chest compression depth on compliant surfaces, as much as 40% of the recorded depth accounts for surface, rather than chest compression.[2]

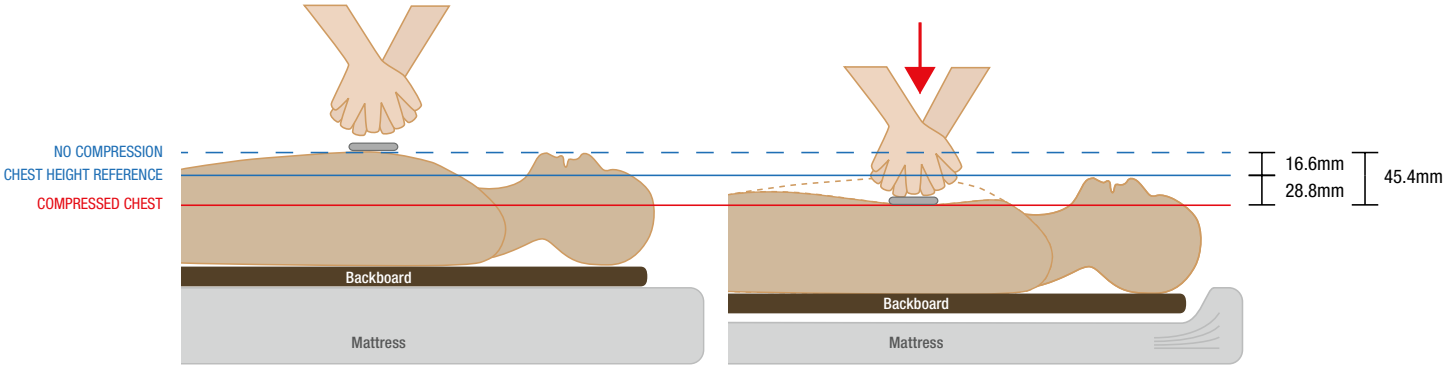

FIGURE 1. Schematic representation of the compression of the chest and the mattress when CPR is performed on a foam mattress with a backboard. The feedback received is 45.4mm, but the chest compression achieved is 28.8mm. Accelerometer-based devices will sense the sum of the chest compression plus the downward movement of the mattress.[3]

We compared CPR quality improvement provided by feedback from a commercial accelerometer-based (ACC) device and the Triaxial Field Induction (TFI) technology utilized by the TrueCPR™ Coaching Device.

Methods:

- Twenty-two critical care nurses were randomized to device type and performed 2-minute sets of continuous chest compressions with and without feedback.
- The Resusci® Anne (Laerdal) manikin was weighted (51kg head-to-pelvis) and placed on a backboard on a hospital bed with foam mattress.
- Compression quality was measured with Resusci Anne® SkillReporter™ (Laerdal). Manikin depth accuracy was verified to be within 1mm.
- Accelerometer tested was Philips Q-CPR™

Group 2: Accelerometer (ACC) Feedback

- Compression depth with ACC trended higher but was not significantly increased (p=0.07). (TABLE 1)
- Average depth was >50mm in 2/11 participants with ACC feedback vs. 1/11 at baseline–manual without ACC).
- The compression depth recorded by the ACC device was greater than recorded by the manikin (52.9±8.4 vs. 44.3±7.1mm, p=0.03). (TABLE 1)

TABLE 1. Chest compression performance summary.		
	Group 1 TFI	Group 2 ACC
Number of Patients	11	11
Depth at baseline (mm)	44.1 ± 8.1 ‡	40.5 ± 9.7
Depth with feedback (mm)*	54.0 ± 8.6 ‡	44.3 ± 7.1
Rate at baseline (/min)	106 ± 18	96 ± 16 ‡
Rate with feedback (/min)*	94 ± 9	107 ± 10 ‡

Mean ± standard deviation
* Unpaired t-test comparing Group 1 vs Group 2. $p<0.05$
‡ Paired t-test comparing baseline vs with feedback, $p<0.05$

Conclusion:

- Accelerometer-guided feedback reported depth significantly higher than actual depth (52.9mm reported vs. 44.3mm actual).
- The difference is representative of mattress deflection under compression.
- TFI guided rescuers to correct target zone of 54.0mm, significantly improving chest compression depth.
- In a realistic simulation on a hospital bed, use of a TFI CPR feedback technology by nurses significantly improved their chest compression depth compared to no feedback or to accelerometer-based feedback.
- TFI feedback technology allows CPR depth performance that is not impeded by the presence of a mattress.
- This study was conducted with a TFI device that provided only a metronome tock (at 100 cpm) and no compression rate feedback to the user. The TFI device has since been modified to provide the user compression rate feedback on the device dial and the metronome tock rate was increased to 104.4 ± 1 cpm. Validation of the final, marketed TrueCPR device with TFI confirmed users were able to consistently provide compressions at a Guidelines' consistent rate of >100 cpm.

Discussion Points

Real-Time Performance Feedback

- The International Liaison Committee on Resuscitation (ILCOR) and its partners have published recommendations that continue to drive more aggressive CPR performance standards. The 2010 AHA Guidelines for CPR & Emergency Cardiac Care includes CPR protocols for 2" minimum compression depth at least 100cpm for two-minute intervals including full chest recoil.[4] In addition, the 2013 AHA Consensus Statements on CPR Quality highlight a growing body of clinical evidence emphasizing CPR performance metrics, such as compression depth and rate.[5] However, rescuer fatigue has become an issue. During in-hospital CPR CC depth decay has been shown to occur in as little as 60 seconds of CPR.[6]
- Real-time CPR feedback has the potential to effectively guide the operator towards higher quality compressions. However, the limitations of accelerometer-based technologies on soft surfaces have been well documented.[2,5,7-17] These devices over-estimate actual compression depth on surfaces commonly found in the emergency care environment including beds, couches and stretchers. As such they may guide the operator to CPR performance that is less than optimal.
- The TrueCPR device with TFI addresses these limitations, allowing for accurate depth measurement that isolates chest compressions even on soft surfaces.
- This test yielded the desired results:
  1. Significantly improving chest compression depth.
  2. Achieving depth above the recommended minimum performance standard despite use on a soft mattress.
- In contrast, conventional accelerometer technology failed on both counts; in this evaluation there was no improvement in compression depth, and the final result was still below the 2010 Guidelines minimum on the same surface.

Post-Event Performance Feedback

- Effective CPR feedback is only one component in improving CPR performance. Research shows significant results can be achieved through the use of comprehensive post-event review applied to ongoing training and development.18-21 The TrueCPR device is an important component of the Physio-Control System of Care. TrueCPR automatically gathers CPR performance data which can be reviewed immediately following the event on the device itself, or downloaded with a printed report for even greater detail. This data can be used for individual debriefing and identifying overall training opportunities.

System of Care

- The TrueCPR device is an important component of Physio-Control's System of Care. The TFI technology used by The TrueCPR device provides accurate real-time and post-event feedback for CPR performance improvement. In addition to real-time feedback, Physio-Control also offers LUCAS® 2 Chest Compression System – an effective and easy-to-use mechanical CPR solution designed to deliver Guidelines-consistent compressions on each stroke without fatigue while freeing hands and improving user safety. The LIFEPAK® 15 monitor/defibrillator and the LIFEPAK 20e defibrillator/monitor with CodeManagement Module® combine the simplicity of a CPR Metronome for rate control with industry-leading Microstream® end-tidal CO_2 technology as a true physiological measure of perfusion. CODE-STAT™ Data Review Software with CPR Analytics provides detailed analysis and reporting of CPR performance.

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